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and Animal Spirits

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Demand, Supply, and Animal Spirits

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Abstract

One of the main topics of macroeconomics analysis is to assess the causes and transmission of business cycles. In order to address this issue, macroeconomists have analysed the response of output to different types of shocks. However, since a shock is by definition an unobserved variable, there is no consensus in the literature about how to properly identify a shock. In this paper we present a framework for identification of shocks that builds on the statistical definition of a shock and imposes as little a priori restrictions as possible on the structure of the system. We apply our methodology to U.S. data, and identify three different shocks, demand/spending, supply/productivity and animal spirits/preferences. We conclude that over the last 50 years the U.S. economy has been driven by a blend of the three shocks, being the demand/spending shock more important for the short run variability and during recessions, and the supply shock for the long run trend. However, the last U.S. recession of the 90's seems to have been caused by a combination of both supply and animal spirits disturbances. Finally, we show that, with our identification, there is evidence of positive demand non-neutralities in the long run in the U.S. economy.

Keywords: Shocks, Demand Non-Neutrality

JEL Classification nos: C68, E32, F41,

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1 Introduction

In the recent years, one of the most active branch of macroeconomics, both at the theoretical and empirical level, has been the study of the causes and transmission of business cycles.

At the theoretical level, the work of Kydland and Prescott (1982) and Long and Plosser(1983) gave way to an impressive amount of literature that has tried to identify the causes and transmission mechanisms of economic fluctuations in the framework of computable dynamic general equilibrium models. Starting from the initial result of Kydland and Prescott that technology shocks could be responsible for 70 % of the output fluctuations in the U.S., other types of sources of fluctuations and transmission mechanisms, as government spending, taste or monetary shocks, have been added to the model with varying success, both at the national and the international level (see, for example, Christiano and Eichenbaum (1992) or Canova and Ubide(1995)).

Empirically, the Vector Autoregression framework pioneered by Sims (1980) has been widely utilized as the main tool for business cycle analysis. An application of this framework is the study of the impulse response functions, with which we can evaluate the effect of a shock in a variable on the rest of the variables of a system. However, this approach encounters the problem that in order to be able to say that a shock affects output in a given way, we have to properly identify the shock. But a shock is by definition an unobserved variable, and therefore different ideas have been put forward about how to identify the shocks.

Traditionally, VAR identification has been achieved by estimating the unconstrained reduced form summarizing the joint process and using a set of just-identifying restrictions to go from the reduced-form innovations to a set of uncorrelated innovations. This is done by imposing constraints either on the covariance matrix of the residuals or on the lag structure of the moving average representation of the VAR. The restrictions can be imposed on the contemporaneous short run effects of the innovations on the variables of the system, through the orthogonalization of the reduced-form innovations either via a Cholesky decomposition (Sims (1980)) or via structural economic identification (Bernanke (1986), Evans (1989), Blanchard (1989) and many others); an alternative

approach makes use of the nonstationarities found in the data and imposes long run restrictions on the dynamic effects of these innovations (see Shapiro and Watson (1988), Blanchard and Quah (1989) or Dolado and Lopez Salido (1995)); Gali (1992) uses a combination of both short and long run restrictions. All these approaches rely on constraints derived from economic theory. However, sometimes the theory does not provide enough information on these short or long run relations and alternative approaches to identification must be used, such as the one of Sims (1986) and Canova (1991), which uses knowledge about the flow of information in the economy to restrict the matrices, or the one of Reichlin and Lippi (1994), which introduces identification constraints by approximating the impulse response functions of the system to a particular shape.

The issue of what causes business cycles has become even more popular with the last recession of the 90s. A huge amount of work has been devoted to the task of identifying the causes of the recession, with surprisingly contradictory results. For example, Hansen and Prescott (1993) and Blanchard (1993), with completely different approaches (calibrated real business cycle model vs. structural VAR) arrive at the conclusion that the recession was caused by an adverse technology shock (Hansen and Prescott) or an adverse demand/consumption shock (Blanchard). Cochrane (1994) provides an extensive analysis of different VAR specifications and compares the impulse responses with that of theoretical models. He concludes that none of the popular candidates (technology, money, credit, oil price shocks) can account for the bulk of economic fluctuations.

This paper tries to contribute to the clarification of what causes business cycles by presenting in Section II a new way of identification of shocks in a trivariate output-unemployment-consumption Vector Autoregression. Our approach introduces only contemporaneous/short run restrictions, but does not use the traditional Cholesky decomposition used by, for example, Sims (1980), to obtain the identification. The important difference of our approach is that instead of using a fully-fledged macroeconomic model to achieve identification we exploit our statistical definition of shocks. These shocks can then be interpreted, within a fairly general macroeconomic framework, as demand, productivity and preferences shocks. Our identification can be related to that of Evans

(1989), who uses the standard Cholesky decomposition, or to Blanchard (1989), who introduces only structural short run constraints to identify the shocks in a traditional Keynesian model. It could also be compared to Blanchard and Quah (1989), who use an output-unemployment system but introduce long-run restrictions. The advantage of our approach is that we do not introduce any long run structure into the system, and this allows us to test the significance of the long run responses of the variables to the different shocks and check the validity of the traditional long run restrictions. In addition, we allow for a third source of disturbances. Finally, we are able to meaningfully identify shocks without putting too much economic structure into the system.

This framework allows us to identify three shocks, namely demand/spending, supply/productivity and animal spirits/preferences, and to compute the dynamic responses of the economy to each type of shock and some measure of its contribution to the variability of each variable over different horizons. We also give some informal interpretation of U.S. GNP fluctuations making use of this decomposition. With this framework we participate in the debate of what drives the economy in the short run and, in addition, the identification of the VAR without any long run constraint allows us to test for long run non-neutralities. In Section III we apply this methodology to the U.S. The results show that over the last 50 years the U.S. economy has been driven by a blend of the three shocks, being the demand/spending shock more important for short run variability and during recessions and the supply disturbance for the long run trend. However, the last U.S. recession of the 90's seems to have been caused by a combination of both supply and animal spirits disturbances. Finally, we show that, with our identification, there is evidence of positive demand non-neutralities in the long run in the U.S. economy. Section IV concludes.

2 An Econometric Framework

Consider initially a 2×1 vector of purely non-deterministic weakly stationary random variables, $x(t)$, each of which is $I(0)$. By the Wold theorem

$x(t)$ can be expressed as an infinite order vector moving average (VMA)

$$x(t) = C(L)c(t) \quad (1)$$

where $C(L)$ is a matrix polynomial in the lag operator L . $C(L) = I + C_1L + C_2L^2 + \dots$ and $c(t)$ is a 2×1 vector of serially uncorrelated random variables with zero mean and variance Σ .

If we consider the structural form

$$x(t) = B(L)v(t) \quad (2)$$

identification in the VAR literature consists on finding a matrix A such that

$$C(L)AA^{-1}c(t) = B(L)v(t) \quad (3)$$

satisfies some conditions deduced from economic theory, and restrictions are usually placed on Σ_v and on $B(1)$ and/or $B(0)$.

However, we depart from this traditional approach and instead proceed by defining from (1) a shock to variable j as

$$x_j(t) - E_{t-1}[x_j(t)] = c_j(t) \quad (4)$$

where E_{t-1} is the expectation operator conditional on the information set including all the variables in the system up to and including $t-1$. Notice that although the vector $c(t)$ will be a vector of shocks to the x 's, we still cannot identify them with a particular type of shocks (e.g demand or supply). The reason is that a shock to the first variable will have effects on the other variables of the system due to two alternative mechanisms. The first one will be the propagation mechanism of the system which, in our case, is given by the polynomial matrix $C(L)$. Second, given our definition of shocks, a current shock to one variable is likely to be correlated with a shock to another variable in the system.

In this system, the response at time $(t+k)$ of variable $x_j(t)$ to a shock in variable $x_s(t)$ at time t would be

$$\frac{\partial x_j(t+k)}{\partial c_s(t)} = C_k \frac{\partial c_j(t)}{\partial c_s(t)} \quad (5)$$

and the question would be what does $\frac{\partial e_j(t)}{\partial e_s(t)}$ represent?

If we consider a 2×1 vector $e(t)$ and assume that it follows a bivariate gaussian distribution with mean zero and variance-covariance matrix Σ . using the laws of the conditional probability we can express the expectation of $e_2(t)$ conditioned on $e_1(t)$ as

$$E[e_2(t) | e_1(t)] = E[e_2(t)] + (\sigma_{21}/\sigma_1^2)(e_1(t) - E[e_1(t)]). \quad (6)$$

where σ_{21} is the covariance between the elements of the vector $e(t)$. and σ_1^2 is the variance of $e_1(t)$. This allows us to express $e_2(t)$ as

$$e_2(t) = (\sigma_{21}/\sigma_1^2)e_1(t) + w(t). \quad (7)$$

with $E[w(t)] = 0$, $E[e_1(t)w(t)] = 0$ and $E[w(t)^2] = \sigma_2^2 - \sigma_{21}^2/\sigma_1^2$.

This implies that

$$\frac{\partial e_j(t)}{\partial e_s(t)} = \frac{\sigma_{js}}{\sigma_s^2} \quad (8)$$

and then we can define the *Conditional Impulse Response* (CIR) at time k of variable j to a shock to variable s as

$$CIR_k(j, s) = C_k \frac{\sigma_{js}}{\sigma_s^2} \quad (9)$$

Now we can rewrite (1) as

$$x(t) = C(L) \begin{bmatrix} 1 \\ \sigma_{21}/\sigma_1^2 \end{bmatrix} e_1(t) + C'(L) \begin{bmatrix} 0 \\ 1 \end{bmatrix} w(t). \quad (10)$$

The new system presents again two kind of shocks $e_1(t)$ and $w(t)$ but now they are uncorrelated. Moreover, from this last representation we can decompose each series into two unobserved components: one driven by the shock $e_1(t)$ and the second driven by the shock $w(t)$, this last shock representing the part of $e_2(t)$ which cannot be explained by $e_1(t)$.

At this point we can proceed with the identification of the shocks. Assume for example that $x_1(t)$ is the GNP cycle and that $x_2(t)$ is unemployment (see the discussion below on the unit root properties of the

series). This would imply

$$\begin{aligned}x_1(t) &= C(L)c_1(t) \\x_2(t) &= C(L)(\sigma_{21}/\sigma_1^2)c_1(t) + C(L)w(t)\end{aligned}\quad (11)$$

The first equation would be a traditional demand equation, in which innovations in output are entirely attributed to demand innovations, $c_1(t)$, along the lines of Blanchard (1989). This is equivalent to assume that supply shocks have no direct effect on output within the quarter. The second equation can be interpreted as an Okun's law, in which innovations in unemployment given innovations in output are attributed to supply/productivity innovations, $w(t)$. It should be noted that these supply innovations can reflect not only productivity shifts that affect employment given output but also changes in labor supply which affect unemployment given employment. However, Blanchard (1989) shows that there is evidence that innovations to productivity play a dominant role in this composite disturbance.

This equation could also be interpreted as a constant returns to scale aggregate production function

$$y(t) = a(l(t) - u(t)) + w(t) \quad (12)$$

where $l(t)$ is total labor force and $u(t)$ is unemployment, and therefore $(l(t) - u(t))$ represents the labor input. Assuming a fixed labor supply and rearranging, we obtain

$$u(t) = l - by(t) + cw(t) \quad (13)$$

where a , b and c are parameters. Therefore $w(t)$ would represent changes in unemployment for a given level of output and a fixed labor supply caused by variations in factor productivity. If we again assume that the cyclical effect of changes in labor supply is minor, we can interpret $w(t)$ as the traditional Solow residual used in the growth and real business cycle literature as a measure of technology shocks. Thus, our identified supply/productivity shocks can be related to both Keynesian and neoclassical interpretations.

Notice that although the methodology is different, the outcome of our identification scheme can be interpreted as a particular case of (2)-

(3). If we define A equal to $\begin{bmatrix} 1 & 0 \\ \sigma_{21}/\sigma_2^2 & 1 \end{bmatrix}$ then $B(L)$ in (2) would be equal to $C'(L)A$ and

$$v(t) = A^{-1}e(t) = \begin{bmatrix} e_1(t) \\ (e_2(t) - \sigma_{21}/\sigma_2^2)e_1(t) \end{bmatrix} = \begin{bmatrix} e_1(t) \\ w(t) \end{bmatrix} \quad (14)$$

Therefore, the result of our identification procedure yields a lower triangular matrix with ones in the main diagonal.

So far we have a system with supply (technology) and demand (spending) shocks. However, there is a third source of shocks which we would like to consider and that does not belong to any of these, which is preferences shocks. These shocks, often referred to as "animal spirits" shocks, change the consumption patterns of consumers and modify the cyclical behaviour of output. These shocks have been widely used in the International Business Cycle literature as a way to reconcile the low international consumption risk sharing that is found in the data with the consumption smoothing properties of the neoclassical growth model with complete capital markets. The introduction of these shocks has been criticised because they are unmeasurable or unexplainable. However, Canova and Ubide (1995) suggest that household production shocks, in the framework of an open economy business cycle model, can provide a rationale for these preferences shocks, because shocks to the home production technology modify the price and substitution mechanism of the agents and affect in particular their labor and consumption decisions (see Benhabib, Rogerson and Wright (1991) for an analysis of the role of home production in dynamic general equilibrium models).

It should be noted as well that with this shock identification we are restricting our range of possible shocks to real variables, and that any shock coming from prices, such as terms of trade or interest rates, can be accommodated into our three shocks. For example, a negative terms of trade shock can affect both spending and productivity negatively; a positive money supply shock can result in an increase in spending. The distribution of each of these shocks across supply, demand and preferences will depend on each particular case. This conceptualization of the shocks as demand and supply is perhaps more related to the *Keynesian*

view of the business cycle, as opposed to the neoclassical school that decomposes the sources of business cycles between real and nominal.

The extension of the system to accommodate these preferences shocks is not straightforward. Consider in a first step a system including only GNP and consumption, as in Blanchard (1993). In this case, using the same identification technique $w(t)$ in equation (8) would represent a demand/preferences shock. However, the identification of $w(t)$ as a demand/preferences shock would require the assumption that, for a constant GNP ($e_1(t) = 0$), the only source of variation in consumption is a change in tastes and preferences. However, a positive supply shock which keeps GNP constant could induce changes in unemployment and give rise to changes in the distribution of income which could in turn modify the consumption patterns. Therefore, the shocks that Blanchard identified as demand shocks could also incorporate a good deal of supply shocks.

A way out of this problem is to specify a trivariate output-unemployment-consumption VAR. We have shown before that for a given GNP, changes in unemployment can be identified as supply side shocks. Then, as we have already advanced, changes in consumption for a given level of GNP could come from two sources: supply side shocks (a change in productivity for a fixed GNP implies changes in unemployment, income redistribution and possibly changes in consumption) or pure demand/preferences shocks. However, for a given level of GNP and a given level of unemployment, we can identify changes in consumption as pure preference shocks. Thus, we have a sort of consumption function which can be interpreted as depending on income (the demand component), wealth (the supply component) and preferences.

Thus, using again the laws of conditional probability, we have for the trivariate system

$$E[\epsilon_3(t) | \epsilon_1(t)\epsilon_2(t)] = E[\epsilon_3(t)] + \begin{pmatrix} \sigma_{13} & \sigma_{23} \end{pmatrix} \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix}^{-1} \begin{bmatrix} \epsilon_1(t) - E(\epsilon_1(t)) \\ \epsilon_2(t) - E(\epsilon_2(t)) \end{bmatrix} \quad (15)$$

Therefore, we obtain for e_{3t} the following model.

$$e_{3t} = \beta_1 e_{1t} + \beta_2 e_{2t} + v_t \quad (16)$$

where

$$\begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} = \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix}^{-1} \begin{pmatrix} \sigma_{13} \\ \sigma_{23} \end{pmatrix} \quad (17)$$

Operating and rearranging, we can write the system as

$$x(t) = C(L) \begin{bmatrix} 1 \\ \alpha_1 \\ \alpha_2 \end{bmatrix} e_1(t) + C(L) \begin{bmatrix} 0 \\ 1 \\ \alpha_3 \end{bmatrix} w(t) + C(L) \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} v(t) \quad (18)$$

where $\alpha_1 = \sigma_{12}/\sigma_1^2$, $\alpha_2 = (\beta_1 + \alpha_3\alpha_1)$ and $\alpha_3 = \beta_2$.

Therefore, we have now

$$\begin{aligned} x_1(t) &= C(L)e_1(t) \\ x_2(t) &= C(L)\alpha_1 e_1(t) + C(L)w(t) \\ x_3(t) &= C(L)\alpha_2 e_1(t) + C(L)\alpha_3 w(t) + C(L)v(t) \end{aligned} \quad (19)$$

With this structure, $e_1(t)$ would be a demand/spending shock, $w(t)$ would be a supply/productivity shock and $v(t)$ would be a preference/animal spirits shock which, by construction, are uncorrelated.

3 An Application to the U.S.

In this section we apply this methodology to the U.S. in an attempt to evaluate the importance of each of the components we have previously identified for the U.S. business cycle. After a statistical analysis of the series, we will estimate the VAR under the identification scheme we have presented and concentrate on two main issues. The first one will be the study of the contribution of each of the shocks to the variance of output in the whole sample and in different subperiods. This historical analysis will shed some light on the causes of the different cycles of the U.S. economy. This will be completed with the analysis of the correlation

structure of the shocks and its performance during the turning points of the cycle. The second issue will be the dynamic analysis of the effects of the shocks and the implications for both business cycle and long run analysis.

3.1 Data Analysis and Estimation

The data is quarterly real seasonally adjusted G.N.P., real private Consumption and Unemployment taken from OECD Main Economic Indicators for the period 1959:1 to 1994:3. Figure (1) presents the plots of the series. Looking at the graph it is clear that the first step towards analysing these series is the evaluation of a potential unit root in them.

Given the tendency of the output and consumption series to trend up over time (see the discussion below regarding unemployment) we have considered that the alternative hypothesis to be tested is that the series are stationary around a constant term and a deterministic trend. In order to test for this alternative hypothesis, we have computed the Augmented-Dickey Fuller test (ADF_t), where the number of lags in the autoregression has been chosen in order to minimise the Hannan and Quinn (1979) criterion. This criterion performs at least as well as others in the study by Hall (1993). The critical value is -3.43, and the results are reported in Table 1 with the selected number of lags in brackets.

Table 1: Unit root tests

	GNP	CONSUMPTION
ADF_t	-2.50 (1)	-1.61 (6)

Inspection of Table 1 indicates that there is no evidence to reject the unit root hypothesis in the series. In fact, none of the statistics comes close to rejection. The evidence regarding unemployment is not conclusive. It is commonly maintained that unemployment should be stationary, because otherwise we would be admitting the possibility of unemployment reaching unbounded positive levels. However, some recent

literature has stressed the presence of hysteretic effects on unemployment (see, e.g., Blanchard and Summers (1986)), in particular in European countries, which could derive from mechanisms such as insider-outsider and discouragement effects or the existence of large firing and hiring costs (see Bean (1994) and Blanchard and Jimeno (1995) among many others). In these cases, a shock to unemployment could have permanent effects in the long run (see Dolado and Lopez Salido (1995) and Lopez, Ortega and Ubide (1996) for an application to the spanish case in a VAR framework). The empirical evidence is also contradictory, because there is evidence supporting both the $I(0)$ hypothesis (Nelson and Plosser (1982), Schwert (1987)) and the $I(1)$ (Fabrizio (1995)). Because of this contradictory evidence, we will assume in what follows unemployment to be $I(0)$ as it is done, for example, in Evans(1989) or Blanchard and Quah (1989).

Therefore, we then proceed with the cointegration analysis between Y and C by fitting a VAR(4) to the series. This lag-length ensures that the Hannan and Quinn criterion is minimised and that the errors do not present problems of serial correlation. In order to test for the number of cointegration vectors we follow Johansen (1988) approach. Johansen proposes two different tests in order to test for the null hypothesis of r cointegration vectors, with different alternative hypothesis.

The first (Trace Test) tests the restriction $r \leq k$ ($k < N$) against the completely unrestricted model $r \leq N$. In the second test (λ_{max}) the alternative is made more precise: that only one additional cointegration vector exists (that is, $r \leq k+1$). Table 2 contains the results of Johansen cointegration tests for the GNP-C system.

Table 2: Johansen Cointegration Tests

<i>GNP-C SERIES</i>					
	λ_i	Trace-test	λ_{max} -test	5% c.v. Trace	5% c.v. λ
$r \leq 1$.042	5.961	5.961	8.18	8.18
$r = 0$.075	16.820	10.862	17.95	14.90

Inspection of Table 2 reveals that the series are not cointegrated.

Therefore, we proceed now to estimate the VAR $[\Delta Y U \Delta C]$ with the identification procedure presented in Section 2. Table 3 reports the statistics of the residuals of the estimated model.

Table 3: Main statistics of the residuals

EQUATION	<i>GNP-EM-C</i>			
	BL	SKEW	KUR	JB
GNP	17.44	-.25	.56	3.26
EM	18.50	-.02	-.04	.18
C	18.53	-.04	-.26	.43

Inspection of Table 3 indicates that there is no serious problem of serial correlation in the residuals. The values of the univariate Box-Ljung statistic (BL) for the residuals of each equation are 17.44, 18.50 and 18.53, which under the null hypothesis of independence of the residuals is distributed as a $\chi^2(20)$, (cv 31.41), and therefore we can accept the null hypothesis of independent residuals.

Next we have computed the skewness (SKEW) and the excess of kurtosis (KUR). If the residuals are assumed to be independent, under the null hypothesis of normality these statistics are asymptotically distributed as a $N(0.6/T)$ and a $N(0.24/T)$ respectively. Therefore, we could perform an asymptotic test based in the comparison of the absolute value of these statistics with 1.96 times $(T/6)^{1/2} = .407$ and 1.96 times $(T/24)^{1/2} = .814$ respectively. Inspection of Table 3 indicates that we can accept the hypothesis that these statistics take the typical values of a Normal distribution for the residuals.

Finally we have computed the Jarque and Bera (JB) statistic for normality, which is distributed as a $\chi^2(2)$ (critical value at the five percent level is 5.99) under the null hypothesis of normality. In this case the normality assumption is accepted for all the series.

3.2 Historical Analysis

Once we have estimated the system we proceed to the identification of the shocks and decompose the GNP series into three components: demand/spending, supply/technology and animal spirits/preferences. Figure (2) shows the GNP cycle (computed as the first differences of the series) together with the three components we have identified.

In order to grasp which has been the quantitative importance over time of each of the components, Table (4) shows the amount of output variance that is due to each of the shocks in different periods. We have splitted the sample size into three periods, each of which covers a decade and goes from recession to recession: the sixties (1961:1-1970:4), the seventies (1971:1-1980:3), the eighties (1980:4-1990:2) and the nineties (1990:3-1994:3).

Table 4: Historical Decomposition of GNP

	1959-1994	61:1-70:4	71:1-80:3	80:4-90:2	90:3-94:3
Demand Shock	64.22 %	56.08%	70.86 %	70.76%	79.80%
Supply Shock	22.05 %	30.14%	10.11%	20.21%	11.27%
Animals Shock	13.77%	13.78%	19.03 %	9.04 %	8.92 %
Var (GNP)	0.24	0.12	0.36	0.23	0.19

As we can see from the table, taking the whole sample size the demand shock accounts for more than half (64.22%) of the variance of output, the supply shock for the 22.05% and the animal spirits shock for a 13.77%. This contribution has not been constant over time, and this variation can explain the different nature of the cycles that the U.S. economy has experienced over the last forty years. We can also see that the demand/spending shock has been more important in the periods in which the variance of output has been lower (sixties and nineties), whereas its contribution has been quite smaller in periods of high volatility (seventies and eighties). As a tentative explanation, it seems that productivity

and animals shocks provoke drastic changes that lead to high-volatility cycles whereas demand shocks create smoother cycles, probably because a keynesian stabilization effect dominates.

Table 5: Decomposition of GNP changes in recessions and expansions

	E	R	E	R	E	R
	61:2-69:3	69:4-70:4	71:1-73:3	73:4-75:1	75:2-79:4	80:1-80:3
Demand	0.57	0.46	0.68	0.78	0.60	0.94
Supply	0.30	0.51	0.07	0.18	0.09	0.06
Animals	0.13	0.03	0.25	0.05	0.31	0.00
	E	R	E	R	E	
	80:4-81:2	81:3-82:1	82:3-90:2	90:3-91:1	91:2-94:3	
Demand	0.91	0.65	0.67	0.26	0.79	
Supply	0.06	0.28	0.24	0.31	0.15	
Animals	0.03	0.08	0.08	0.43	0.06	

The sixties was a period of intensive technological innovation, that was helped by a good behaviour of demand and good expectations about the future. We can see in the plots that productivity increased steadily until 1968, the moment in which the "productivity slowdown" detected in the growth literature starts. As it will be the norm during the whole sample, spending is more volatile than supply and animals during this period (with periods of expansion that may correspond to historical episodes such as the 1964 tax cut or the Vietnam war), and therefore its contribution to the volatility of output is large, but it is clear from the plots that the trend in output, upward until 1968 and downward afterwards with a turning point in 1967:4, is due mainly to the behaviour of supply. Around 1967 we can also see the animals component going down, announcing the forthcoming recession. Table (5) and Figures (3) and (4) show a more disaggregated decomposition of output volatility according to the official NBER periods of expansion and recession. According to this table, the 1969-70 recession was due mainly to a negative supply

shock (there was, for example, a General Motors strike in 1970).

The seventies was a period of much wider fluctuations, and the variance of output was more than double with respect to the precedent period. Although the three types of disturbances affected output behaviour, their relative importance varied over time. We see in Table (4) that demand and animals are the components which explain a larger share of output volatility. However, a look at the more disaggregated analysis shows that animals were very important in the periods of expansion, whereas the 1973-75 recession was driven by both demand and supply shocks. The plots reveal again that the animals component announced the recession in early 1973. There is also a downturn in the supply component in early 1973 which may have presumably trigger the recession, and the demand component falls deeply in 1974. The recovery is again fuelled by the spending component with a large contribution of the recovery of expectations after the oil crises.

The minirecession in 1980 is different from the others, and is due almost exclusively to demand. In fact, the plots reveal that the decay in the demand component is larger than the total decrease in output. Demand is also responsible for the subsequent recovery and the next recession, in 1982, is now more similar to the others, with the combined effect of all three factors. This recession leads to a long expansionary and calmer period, the eighties, in which all three components expand the economy until the turning point in 1984. From there, both supply and animals start decreasing whereas demand continues with its more volatile but less clear pattern. The expansionary period of the second half of the eighties is almost entirely due to large spending. After 1988, both supply and animals announce the recession, which arrives in 1990:3. We can see from Table(5) that this is a recession caused by all three shocks, but with the major contribution, differently from all the other recessions, of supply and animals. Finally, the recovery of spending leads the expansion, although we can see in Figures (3) and (4) that in 1992 both demand and supply decrease and is the animals component which drives output up.

We can draw some conclusions from this historical analysis. The

demand component has been always much more volatile than supply and animals, but it has been in general supply who has set the trend of the economy. The behaviour of the economy has been different in the different parts of the cycle. The demand component has been significantly more intense during recessions, although recessions have been in general the result of all three components, and only the 1980-81 recession can be attributed to a single one. The recession of the 90s has been different from the previous ones, because it can be mostly attributed to the effect of both supply and animals.

It may be interesting to see how these different components have behaved not only during recessions but also in the different turning points of the business cycle, because in general animals have led the cycle, at least in the downward part, and supply sometimes lagged behind in the recoveries. In order to do so we have superimposed in Figures (5) and (6) the official NBER dates of the peaks and troughs of the U.S. business cycle. We can see that our measure of the business cycle captures fairly well the turning points. In terms of the different components, it seems that both demand and supply capture relatively well the turning points and that the animal spirits are leading the cycle to some extent. In order to confirm this issue, we follow the Real Business Cycle methodology and compute the correlations of output with lags and leads of the two shocks in order to see whether there is any lead/lag pattern in the series.

Table 6: Correlation (GNP_t , $Shock_{t+i}$)

i=	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Demand	-0.07	0.01	0.06	0.07	0.29	0.81	0.34	0.12	0.11	0.05	0
Supply	-0.07	-0.07	0.02	0.02	0.16	0.39	0.25	0.21	0.17	0.01	0
Animals	0.11	0.20	0.25	0.28	0.30	0.27	0.16	0.06	-0.02	-0.11	-0.16

The results of Table (6) seem to confirm the previous analysis: both demand and supply shocks seem to comove contemporaneously with output. Instead, animal spirits shocks seem to be leading output to some extent, since the largest correlation coefficients correspond to the

correlation of output with one and two lags of the shock. This means that the preferences shock affects the output of one and two periods ahead. This could be related to a "time to build" structure, in which investment decisions take time to materialize, and therefore changes in expectations imply effective changes in the cycle some periods later.

3.3 Dynamic Analysis

So far we have seen that economic fluctuations in the U.S. have been the result of the interaction of supply and demand components, being the spending component of demand the most important over time. However, apart from this historical analysis we are also very interested in discovering how our shocks move output over the business cycle and which of the shocks is the responsible for the short and long run fluctuations in economic activity. All this can be achieved with the impulse response analysis.

Figures (7) and (8) shows the impulse responses of output and unemployment to the three different shocks. The responses to the supply and animals shocks are as expected: a positive supply shock drives output down temporarily due to the increase in unemployment that the shock produces on impact. Once the firms have absorbed the increase in productivity unemployment decreases and output increases, leading to a long run/permanent effect of the technology shock on output. The shape (although not the magnitude) of the responses is fairly similar to that of Blanchard and Quah (1989), but the important difference is that we have not introduced any long run restriction into the model, and therefore we have *let the data speak* regarding the long run effects of the shocks. Thus, a supply shock identified with only short run restrictions has a long run effect on output. However, this not introduction of long run restrictions in the identification turns out to be crucial for the responses to the demand shock. We obtain the same "hump-shape" as Blanchard and Quah (1989), but the difference is that the demand shock do has a positive long run effect on output, although this effect is smaller than that of the supply shock. Therefore, the identification schemes based on

the assumption that demand shocks have no effect on the long run may be wasting a good deal of information. Demand shocks can have positive long run effects on output via endogenous growth effects through "learning-by-doing": for example, government spending that enhances productivity in the long run because in periods of high activity firms and workers learn unusually fast ¹. The responses to the animal spirits shock are also as expected. They are quite smaller and have only transitory effects on both output and unemployment. The interpretation could be a sudden change in expectations about the future that boosts demand temporarily and reduces unemployment.

The effects of the shocks on consumption (Figure (9)) are also of the desired form. A positive demand shock (for example, a cut in tax rates) increases consumption on impact, reaching a peak after 5 periods and returning smoothly to the initial level. This could be interpreted as a lagged Ricardian effect, in which agents react initially to this increase in spending but realize that the current tax cut will imply more taxes in the future and therefore the expansionary effect is only transitory. Instead, a supply shock is perceived by the consumers as a permanent increase in wealth. On impact consumption decreases because the increase in productivity makes investment a more interesting activity than consumption and therefore there is a transfer of resources to productive activities. But after a while the wealth effect overtakes this initial substitution effect and consumption increases, stabilizing after 15 periods. Finally, the interpretation of the response to the animal spirits shock is a bit difficult, because the shock has positive long term effects on consumption. The explanation could be as follows: a positive change in expectations creates a temporary increase in demand and a decrease in unemployment. If this short run effects translate into permanent effects, as it could be the case of positive expectations leading to a permanent decrease in the marginal propension to save, the animal spirits shock can

¹However, some work has been recently developed on "the cleansing effect of recessions", according to which recessions would have positive effects on productivity through reallocation effects (see Caballero and Hammour (1994) and Lippi and Riechlin (1994)), and therefore positive demand shocks would have a negative long run effect on output

have permanent effects on consumption.

Finally, in order to assess more formally the determinants of short and long term output fluctuations, Table (7) shows the Variance Decomposition analysis, which gives us a quantitative evaluation of the contribution of each source of disturbances to the variance of the n quarter-ahead forecast error for each endogenous variable. It is important to note that the only result that is true by assumption is that the one quarter ahead variance of GNP is due entirely to demand.

Three main results emerge from that table:

(1) Innovations to demand and supply account for most of the variance of output at all horizons. However, at short horizons (up to twelve quarters) demand and animals are more important than supply to explain the variance of output. At the medium and long term, demand and supply become the driving forces, and after 36 periods demand explain 62% of the variance of GNP, supply 31% and animals 7%: roughly the figures we have obtained in the historical analysis.

(2) Unemployment is driven by all three shocks at almost all horizons: only at the very short term (four quarters) animals have a very small effect on unemployment. Supply is always the most important, specially in the short term (up to eight quarters) and the contribution of demand is stable over all horizons. Thus, although the shape of the impulse responses was very similar to those of Blanchard and Quah (1989), the variance decomposition is quite different: with their identification, the variance of unemployment is due mainly to demand shocks at all horizons. Our results are closer to those of Blanchard (1989), where the unemployment variance after 28 quarters is explained mainly by supply shocks. However, in our case after four periods supply is also dominant (and even more than after 28 periods) whereas in Blanchard (1989) demand dominates in the short run.

(3) The results for consumption reveal that changes in preferences account for the bulk of consumption variance in the short run. However, in the long run the wealth effect induced by the technology shock dominates. Interestingly, demand disturbances have almost no effect across

all horizons.

Thus, these results merge intuition from both the keynesian and neoclassical view of the economy: output fluctuations are the result of supply and demand disturbances both at the short and long run, and unemployment fluctuations owe a big deal to supply disturbances, although demand and, perhaps animals disturbances have also a word to say at all horizons.

4 Conclusion

In this paper we have addressed the question of what causes economic fluctuations by identifying three sources of disturbances: demand/spending, supply/technology and animals/preferences. Differently from other papers, our identification procedure, based on the statistical definition of shocks, neither contains long run restrictions nor is based in any fully-fledged macroeconomic model. Instead, our identification scheme is consistent with a fairly broad interpretation of macroeconomic fluctuations, and by introducing as little structure as possible in the system we have tried to let the data speak as much as possible.

The results show that over the last 50 years the U.S. economy has been driven by a blend of the three shocks. The demand component has been always much more volatile than supply and animals, but it has been in general supply who has set the trend of the economy. The behaviour of the economy has been different in the different parts of the cycle. The animals component has in general led the cycle, and the demand component has been significantly more intense during recessions. However, recessions have been in general the result of all three components, and only the 1980-81 recession can be attributed to a single one. The recession of the 90s has been different from the previous ones, because it can be mostly attributed to a combination of both supply and animal spirits negative shocks.

The dynamic analysis has shown that short run output movements are dominated by demand shocks; supply shocks have also a significant

contribution, although smaller than advocated by real business cycle theorists. Finally, we show that, with our identification, there is evidence of positive demand non-neutrality in the long run in the U.S. economy, supporting the endogenous growth-learning by doing literature. Therefore, it seems that the U.S. economy is a blend of keynesian and neoclassical influences.

We find this simple exercise to be worthwhile. However, perhaps the no inclusion of nominal variables makes it too simplistic, and the inclusion of a monetary policy shock could be the way to close the circle, although it might be difficult if we want to stick to our identification procedure.

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Table 7: Forecast Error Variance Decomposition

Horizon	GNP			Unemployment			Consumption		
	Demand	Supply	Animals	Demand	Supply	Animals	Demand	Supply	Animals
1	1.0000	0	0	0.2300	0.7700	0	0.0704	0.0029	0.9267
2	0.9588	0.0271	0.0141	0.3146	0.6691	0.0163	0.0827	0.0043	0.9130
3	0.9266	0.0439	0.0295	0.3069	0.6477	0.0454	0.0798	0.0091	0.9110
4	0.8979	0.0410	0.0610	0.2994	0.6037	0.0969	0.0908	0.0234	0.8858
5	0.8735	0.0333	0.0933	0.3010	0.5520	0.1470	0.0993	0.0387	0.8621
6	0.8580	0.0262	0.1159	0.3068	0.5079	0.1853	0.1001	0.0604	0.8395
7	0.8466	0.0230	0.1304	0.3144	0.4723	0.2133	0.0972	0.0879	0.8149
8	0.8368	0.0250	0.1382	0.3218	0.4452	0.2330	0.0918	0.1187	0.7896
9	0.8273	0.0322	0.1405	0.3274	0.4265	0.2461	0.0846	0.1531	0.7622
10	0.8167	0.0443	0.1390	0.3308	0.4148	0.2544	0.0771	0.1903	0.7327
11	0.8045	0.0604	0.1351	0.3323	0.4086	0.2591	0.0700	0.2280	0.7020
12	0.7906	0.0796	0.1298	0.3323	0.4065	0.2612	0.0639	0.2650	0.6711
13	0.7753	0.1009	0.1238	0.3314	0.4072	0.2614	0.0590	0.3002	0.6409
14	0.7590	0.1231	0.1179	0.3301	0.4094	0.2606	0.0553	0.3326	0.6122
15	0.7425	0.1451	0.1124	0.3287	0.4119	0.2594	0.0526	0.3618	0.5856
16	0.7263	0.1662	0.1075	0.3276	0.4141	0.2584	0.0509	0.3877	0.5614
17	0.7109	0.1857	0.1034	0.3268	0.4155	0.2577	0.0498	0.4104	0.5398
18	0.6968	0.2033	0.0999	0.3264	0.4161	0.2575	0.0491	0.4300	0.5209
19	0.6841	0.2189	0.0970	0.3264	0.4159	0.2577	0.0487	0.4469	0.5043
20	0.6730	0.2325	0.0945	0.3265	0.4153	0.2582	0.0484	0.4615	0.4901
21	0.6636	0.2441	0.0923	0.3267	0.4145	0.2588	0.0480	0.4740	0.4779
22	0.6556	0.2540	0.0903	0.3270	0.4136	0.2594	0.0476	0.4848	0.4676
23	0.6492	0.2624	0.0884	0.3273	0.4128	0.2599	0.0471	0.4940	0.4589
24	0.6440	0.2695	0.0865	0.3274	0.4122	0.2603	0.0465	0.5020	0.4515
25	0.6399	0.2754	0.0847	0.3275	0.4119	0.2606	0.0458	0.5089	0.4453
26	0.6367	0.2804	0.0829	0.3275	0.4117	0.2607	0.0450	0.5149	0.4401
27	0.6342	0.2847	0.0811	0.3275	0.4117	0.2608	0.0441	0.5202	0.4357
28	0.6324	0.2883	0.0793	0.3275	0.4118	0.2608	0.0433	0.5249	0.4319
29	0.6310	0.2914	0.0776	0.3274	0.4119	0.2607	0.0424	0.5291	0.4285
30	0.6299	0.2942	0.0759	0.3274	0.4120	0.2607	0.0415	0.5330	0.4255
31	0.6289	0.2968	0.0743	0.3273	0.4120	0.2606	0.0406	0.5366	0.4228
32	0.6281	0.2992	0.0727	0.3273	0.4121	0.2606	0.0397	0.5400	0.4203
33	0.6273	0.3015	0.0712	0.3273	0.4121	0.2606	0.0389	0.5433	0.4179
34	0.6265	0.3038	0.0697	0.3273	0.4121	0.2606	0.0381	0.5465	0.4155
35	0.6256	0.3061	0.0683	0.3273	0.4120	0.2607	0.0373	0.5496	0.4131
36	0.6246	0.3084	0.0669	0.3273	0.4120	0.2607	0.0365	0.5526	0.4108

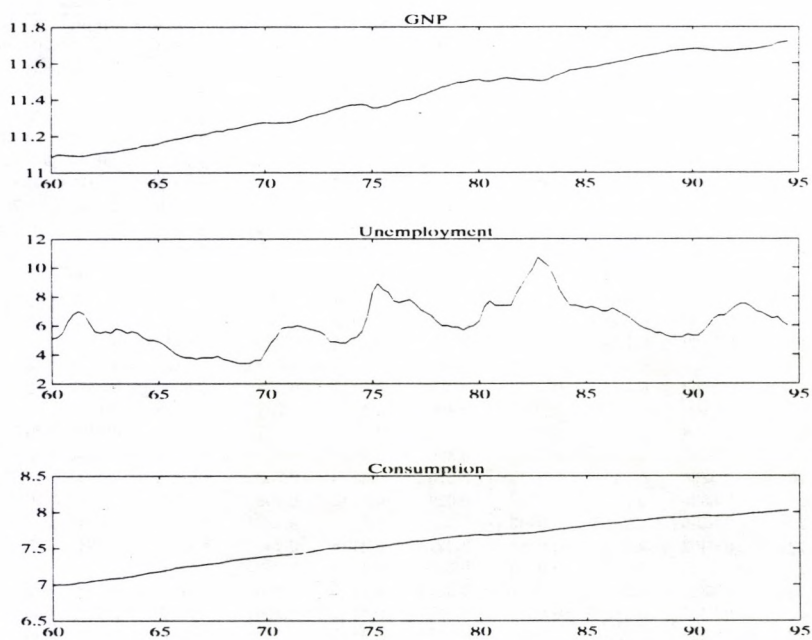


Figure 1: Original Series

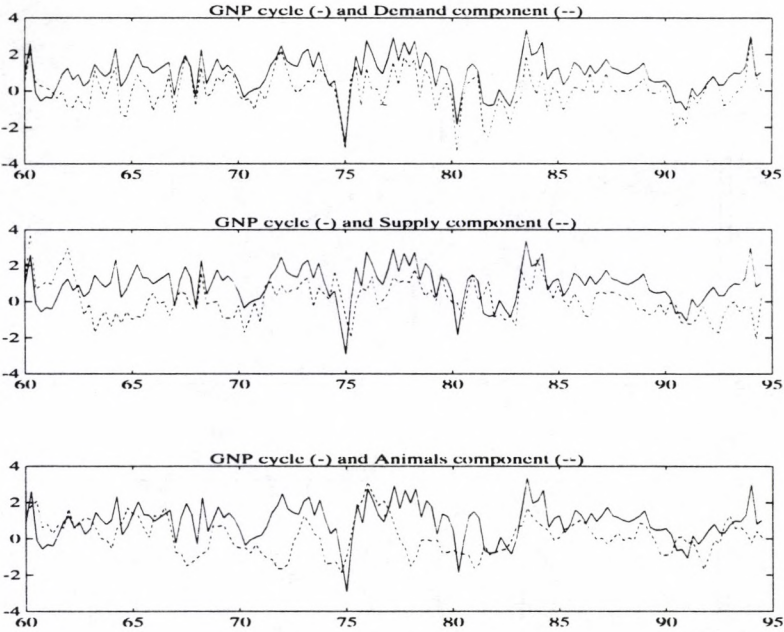


Figure 2: GNP cycle and its components

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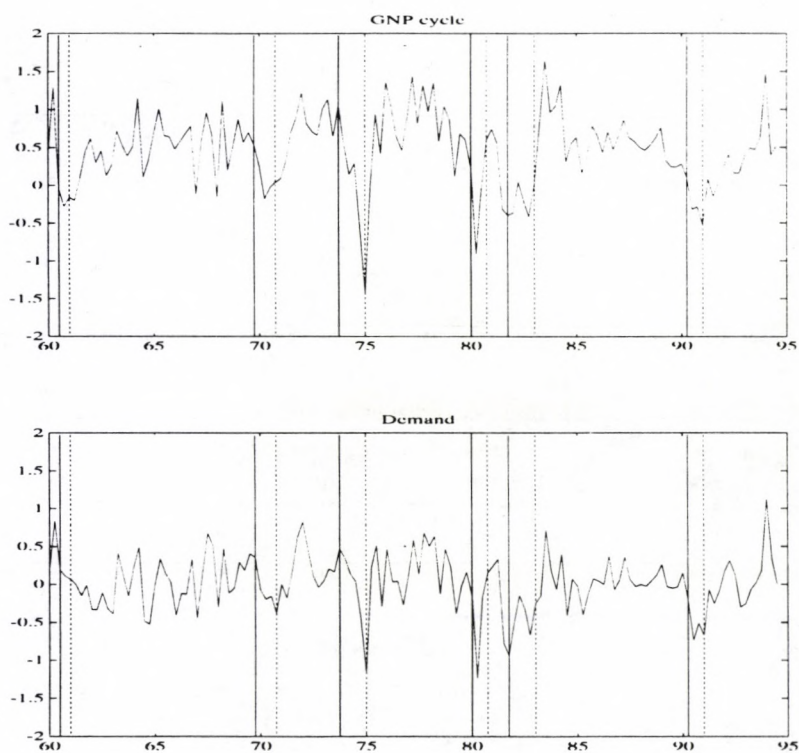


Figure 3: GNP cycle, Demand shock and NBER recessions

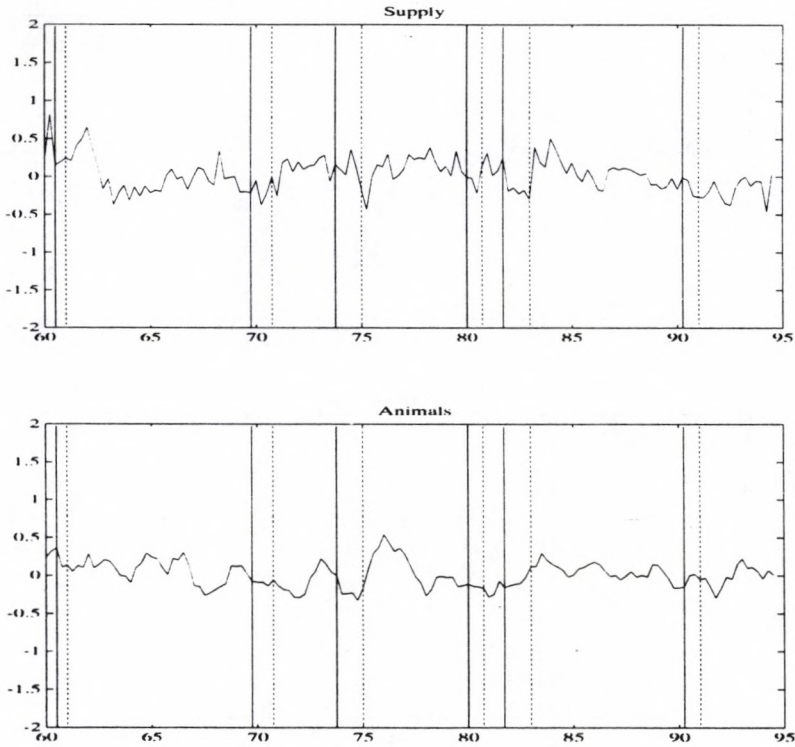


Figure 1: Supply and Animals shocks and NBER recessions

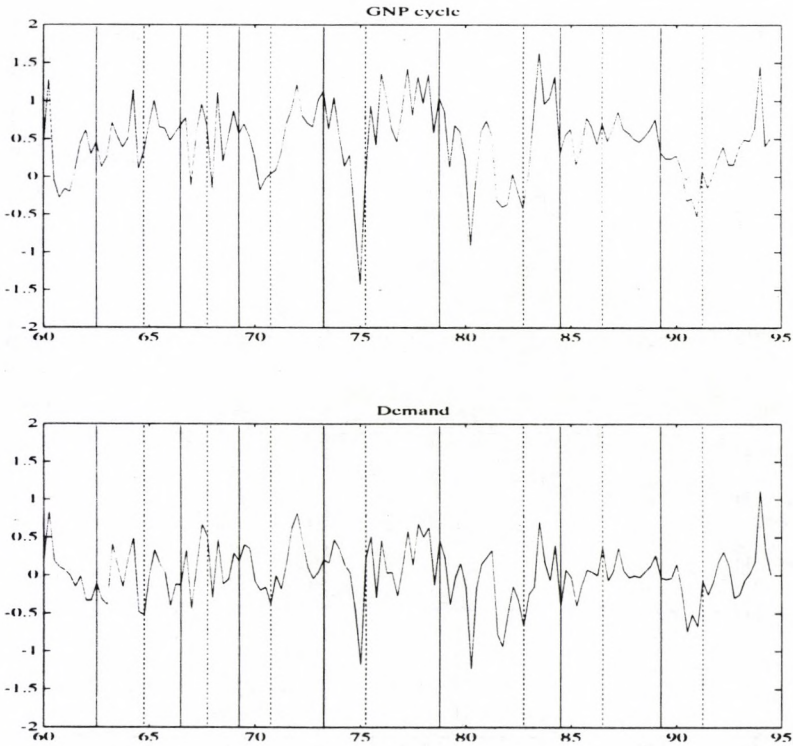


Figure 5: GNP cycle, Demand shock and NBER turning points: Peaks(-) and Troughs (- -)

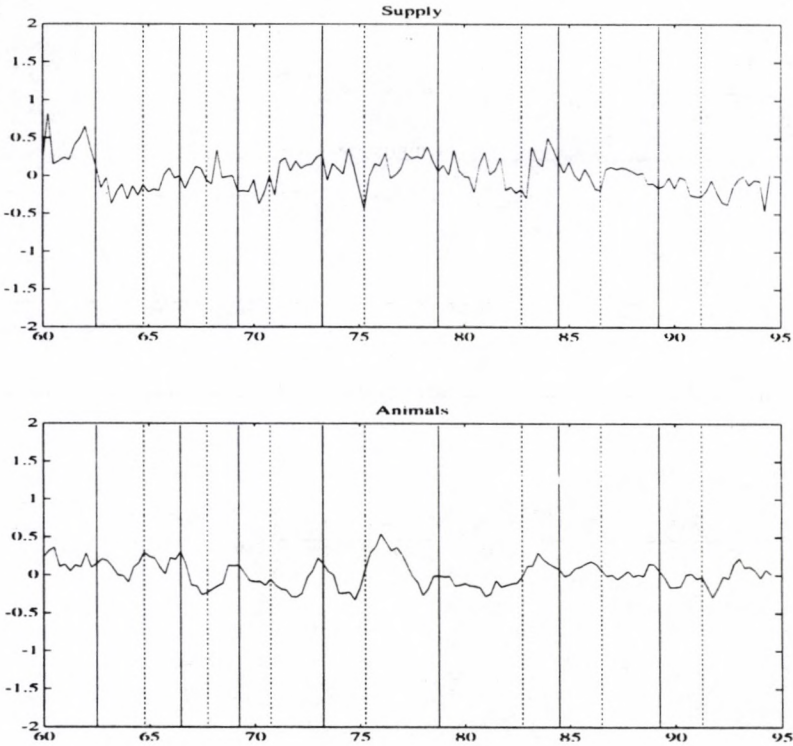


Figure 6: Supply and Animals shocks and NBER turning points: Peaks(-) and Troughs (- -)

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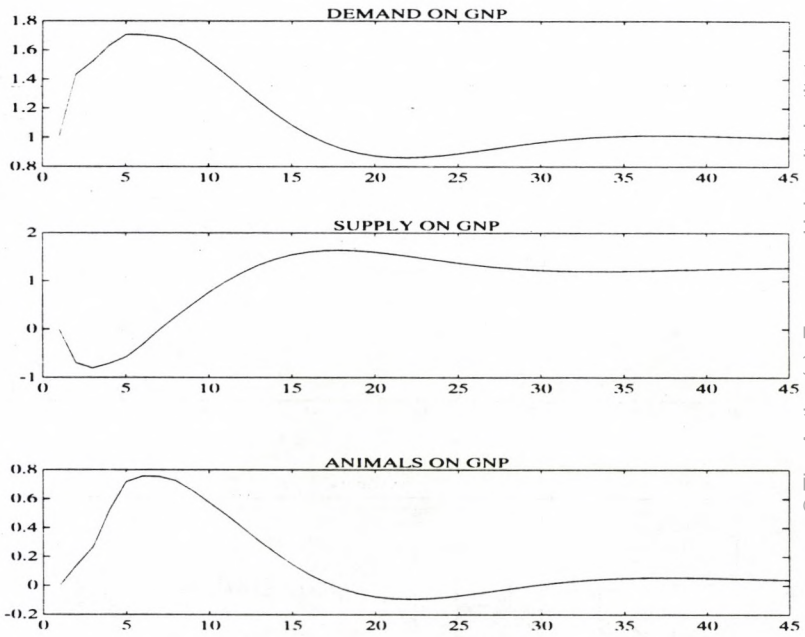


Figure 7: Impulse Responses of Output

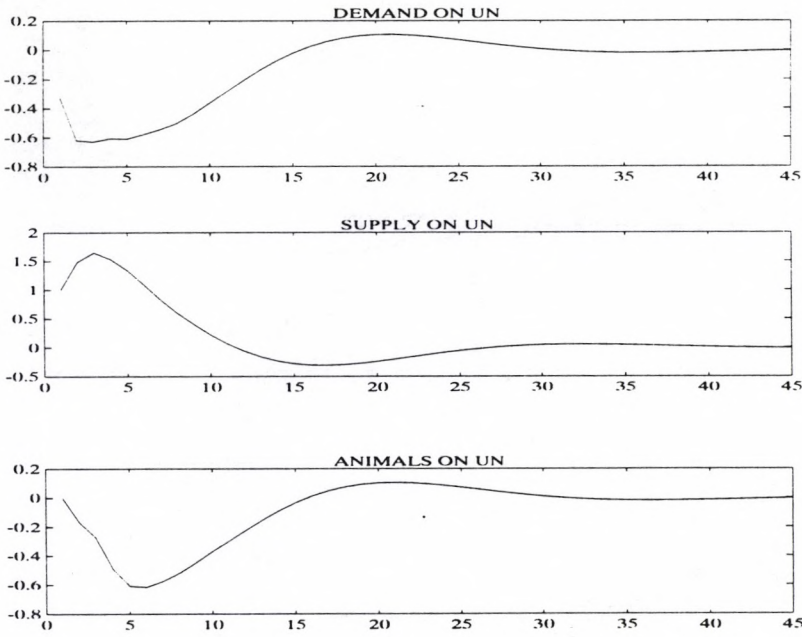


Figure 8: Impulse Responses of Unemployment

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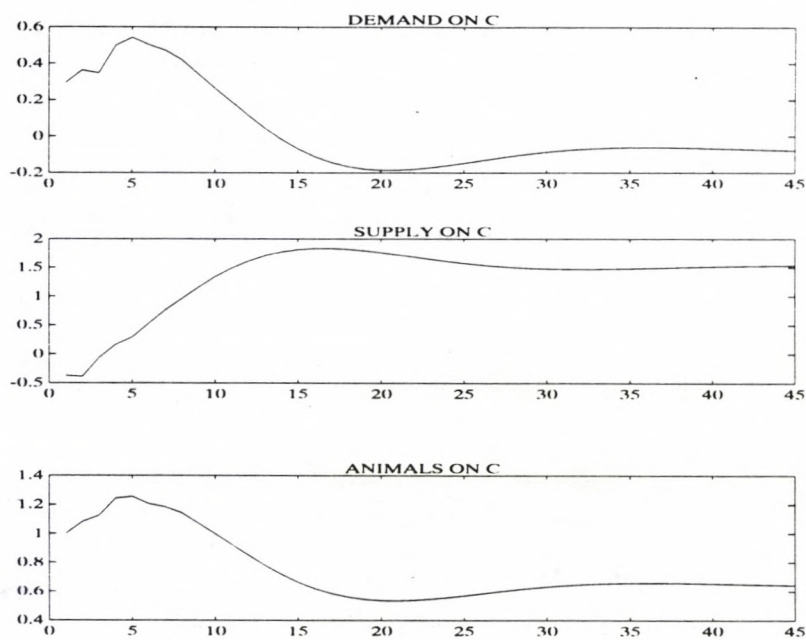


Figure 9: Impulse Responses of Consumption



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